

### **REMARKS**

Further and favorable reconsideration is respectfully requested in view of the foregoing amendments and following remarks.

#### **Claim Amendments**

Claim 2 has been amended to recite that the alloyed powder is subjected to hot extrusion, and the resulting extruded material is subjected to final heat treatment. Support for this amendment is found on page 9, line 23 to page 10, line 4 of Applicants' specification. Claim 3 has been amended to depend from claim 2. No new matter has been added by these amendments.

#### **Rejection of Claims Under 35 U.S.C. § 112, Second Paragraph**

The rejection of claims 2 and 3 as being indefinite under 35 U.S.C. § 112, second paragraph is respectfully traversed.

The Examiner states that claim 2 recites a step of mixing elemental powders and subjecting the powders to mechanical alloying treatment. The Examiner takes the position that neither of these steps would be expected to melt the powders or in any other way cause the powders to be non-solid phase. Further, the Examiner states that claim 2 then recites solidifying by hot extrusion. The Examiner takes the position that either a step of melting the powders has been omitted, or the term "solidifying" is used in other than its accepted meaning.

As discussed above, claim 2 has been amended to recite that the alloyed powder is subjected to hot extrusion, and the resulting extruded material is subjected to final heat treatment. The Examiner's rejection is moot in view of these amendments.

The Examiner also takes the position that there is insufficient antecedent basis for the limitation "the slow cooling" in claim 3. As discussed above, claim 3 has been amended to properly depend from claim 2, thus rendering this rejection moot.

**Patentability Arguments**

The patentability of the present invention over the disclosures of the references relied upon by the Examiner in rejecting the claims will be apparent upon consideration of the following remarks.

**Rejection Under 35 U.S.C. § 102(b)**

The rejection of claim 3 under 35 U.S.C. § 102(b) as being anticipated by Igarashi et al. (U.S. 5,591,391) is respectfully traversed.

The Examiner takes the position that Igarashi et al. disclose a method for making a high chromium ferritic steel containing Nd where Nd forms dispersed oxides, and where the step is subject to heat treatment followed by furnace cooling.

As discussed above, claim 3 has been amended to properly depend from claim 2. Accordingly, claim 3 requires all the limitations of claim 2, and is patentable over the cited reference for the same reasons claim 2 (which is not included in the rejection) is patentable over this reference.

Thus, the invention of claim 3 is clearly patentable over Igarashi et al.

**Rejection Under 35 U.S.C. § 103(a)**

The rejection of claims 2 and 3 under 35 U.S.C. § 103(a) as being unpatentable over Okuda et al. (U.S. 4,963,200) in view of FR 2770020, using U.S. Patent family member Lambard et al. (U.S. 6,485,584) for citations, and JP 63210299 or JP 56044716 [or JP '709] is respectfully traversed. [Although JP '709 is not mentioned in the statement of rejection, the Examiner discusses the reference on page 6 of the Office Action.]

**The Examiner's Position**

The Examiner takes the position that Okuda et al. disclose a method of making a dispersion strengthened ferritic steel. The Examiner further states that Okuda et al. disclose mechanically alloying a powder mixture followed by hot extrusion. The Examiner admits that Okuda et al. do not recite that the heat-treated steel is slowly cooled at a rate of not more than 100°C/hour.

The Examiner further states that Lambard et al. disclose a method for producing oxide dispersion strengthened ferritic steel from powders by using slow cooling at less than or equal to the critical cooling rate for transformation of austenite to ferrite, and teaches that while the exact cooling rate will depend on the alloy composition, good grain growth and ferritic microstructure was produced by cooling at a rate of less than 100°C/hour. The Examiner states that it would have been obvious to subject the cooling rate to optimization in the process of Okuda et al.

The Examiner admits that Okuda et al. in view of Lambart et al. do not disclose the addition of an Fe<sub>2</sub>O<sub>3</sub> powder to the raw material, but that the addition of iron oxide powder is known in the art. The Examiner relies on JPO '299, JP '716 and JP '709 for this assertion.

#### Applicants' Position

It is known that in order to improve the strength (including creep strength) of oxide dispersion strengthened (ODS) ferritic steels, it is effective to finely disperse oxide particles by adding Ti to the steels. Further, for improving the high-temperature creep strength of ODS ferritic steels, it is effective to make grain coarse and equiaxed in order to suppress grain-boundary slidings. As a method of obtaining such a coarse grain structure, there has been proposed, for example, a method wherein a sufficient amount of  $\alpha$  to  $\gamma$  transformation is ensured by performing austenization heat treatment which involves heating to a temperature of not less than Ac<sub>3</sub> transformation point and holding at this temperature, thereby causing austenization to occur by phase transformation from  $\alpha$ -phase to  $\gamma$ -phase. After this step, slow cooling is performed at a sufficiently low rate, i.e., at a rate of not more than the ferrite-forming critical rate, so that a ferrite structure can be obtained by phase transformation from  $\gamma$ -phase to  $\alpha$ -phase. (See, for example, the teachings of Lambard et al.)

However, in the case where Ti is added to an ODS ferritic steel, there occurs a problem that Ti combines with C in the matrix to form a carbide, with the result that the C concentration in the matrix decreases and hence it is impossible to ensure a sufficient amount of  $\alpha$  to  $\gamma$  transformation during austenization heat treatment (heating to a

temperature of not less than  $Ac_3$  transformation point and holding at this temperature).  
(Please see page 2, line 4 to page 3, line 6 of Applicants' specification.)

For example, when both  $Y_2O_3$  and Ti are added according to the teachings of Lambard et al., the sufficient effect of grain growth can not be obtained if the excess oxygen content is not controlled in the predetermined range, as defined in the presently claimed invention. (Please see test material T14 in Applicants' specification.)

On the other hand, the presently claimed invention recites a method of manufacturing an ODS ferritic steel having a coarse grain structure effective in improving high-temperature creep strength. According to the presently claimed invention, even when Ti is added in combination with  $Y_2O_3$ , it becomes possible to obtain the effect of coarsening of grains and improve high-temperature creep strength by controlling the excess oxygen content within the predetermined range, as shown in the test material T3 of Applicants' specification. Therefore, such a method and the resulting effect of the presently claimed invention is different from Lambard et al.

As discussed in the Amendment filed May 29, 2007, Okuda et al. relates to an ODS steel which has been subjected to heat treatment involving normalizing-and-tempering to produce a matrix having a tempered martensitic structure. This means that the martensitic structure has been produced by normalizing, and the tempered martensitic structure having excellent toughness has been produced by tempering. It should be noted that, in Okuda et al., the ferritic structure is not produced by tempering. Thus, fast cooling at a rate of more than a ferrite-forming critical rate has been conducted in Okuda et al.

In the specification of Okuda et al., the wording "dispersion strengthened ferritic steel" is often described. This wording is conventionally used as a general term for meaning a ferritic steel and tempered martensitic steel. The specification of Okuda et al. states, "[A]ccording to the present invention, there is provided a dispersion strengthened ferritic steel which has been treated to produce tempered martensitic structure". (Please see column 2, lines 8 to 10 of the reference.)

Therefore, the method of Okuda et al. for making a dispersion strengthened ferritic steel having a tempered martensitic structure is quite different from the method of the presently claimed invention, in which ODS ferritic steel having a coarse grain ferritic

structure is manufactured by austenitization heat treatment (heating to a temperature of not less than  $Ac_3$  transformation point and holding at this temperature).

The Examiner further cites JP '299 and JP '716 as prior art to teach the addition of  $Fe_2O_3$  powder to the raw material. JP '299 teaches that the addition of  $Fe_2O_3$  powder to a plated layer on the surface of steel sheet is effective in improving the corrosion resistance. JP '716 teaches that the addition of  $Fe_2O_3$  powder to an antioxidizing agent to be coated on the surface of steel is effective in preventing scale forming. However, this corrosion resistance and scale forming prevention is distinct from the high-temperature creep strength which is desired in the presently claimed invention.

To improve corrosion resistance, the conditions of surface, such as the presence of surface coating layer, is important. In JP '299 and JP '716,  $Fe_2O_3$  powder is added to a surface coating material such as a plated layer or a coated layer to thereby improve the corrosion resistance.

On the contrary, in order to improve the high-temperature strength of ODS steel, it is important to control the internal structure thereof. Thus, in the presently claimed invention,  $Fe_2O_3$  powder is not coated on the surface, but is mixed as one of the alloy powders and the resulting mixed powder is subjected to mechanical alloying treatment. By using  $Fe_2O_3$  powder as one of alloy powders, Ti combines with oxygen generated by decomposition of  $Fe_2O_3$  during the mechanical alloying to form an oxide without combining C to form a carbide. Therefore, Ti does not lower the C concentration in the matrix, resulting in formation of coarse grain structure during slow cooling. (Please see page 6, line 16 to page 7, line 2 of Applicants' specification.) Such control of the internal structure of ODS steel for improving high-temperature strength in the presently claimed invention is quite different from controlling the surface condition to improving corrosion resistance.

The Examiner further cites JP '709 as prior art teaching the addition of iron oxide powder for purposes of improving wear and seizure resistance and durability. JP '709 discloses a ferrous sintered alloy, suitable for the sliding parts material for compressor, having a composition consisting of, by weight, 2-4 % C, 1-9 % Cu, 0.3-3 % Sn, 1.5-4 %

Si, and the balance essentially Fe, and also having a structure where free graphite, bronze and iron oxide are dispersed in a matrix of ferrite and pearlite.

In paragraph [0030] of JP '709, there is described as follows:

The sliding parts material for compressor of this invention is manufactured as follows: 2-4 wt % carbon powder, 1-9 wt % Cu powder, 0.3-3 wt % Sn powder and 1.5-4 wt % Si powder are added to iron powder and mixed, and then formed into a predetermined shape. The resulting shaped body is sintered at a temperature of about 1100 to 1150 °C for 0.5 to 2 hours, and the resulting sintered body is subjected to sealing treatment by steam treatment or the like, thereby forming iron oxide.

In paragraph [0032], there is further described as follows:

By the steam treatment, iron oxide is dispersively produced in the holes of matrix structure of the sintered body. It is preferable to set the content of iron oxide to 5 to 20 vol % based on the total volume of the sintered body. The iron oxide improves the wear resistance of the sintered body.

Therefore, JP '709 does not teach the addition of iron oxide powder as raw material powder of the ferrous sintered alloy and does not employ mechanical alloying treatment.

On the contrary, in the presently claimed invention,  $\text{Fe}_2\text{O}_3$  powder is used as one of raw material powders in order to increase the excess oxygen in the steel and mechanical alloying treatment is essentially employed. Specifically,  $\text{Fe}_2\text{O}_3$  is decomposed into Fe and O during mechanical alloying treatment to thereby increase the excess oxygen in the steel. Since the excess oxygen derived from  $\text{Fe}_2\text{O}_3$  combines with Ti having the affinity with oxygen stronger than Fe to form an oxide, and Ti does not combine with C to form a carbide, it is possible to suppress a decrease in the C concentration in the matrix. As a result, coarsening of grains occurs and the high-temperature creep strength is improved.

It is clear from the above discussions that, even by combining the teachings of the references cited by the Examiner, the method of the present invention, as claimed in claims 2 and 3, is not taught or suggested.

For these reasons, the invention of claims 2 and 3 is clearly patentable over Okuda et al. in view of Lambard et al. and JP 63210299 or JP 56044716 [or JP '709].

**Conclusion**

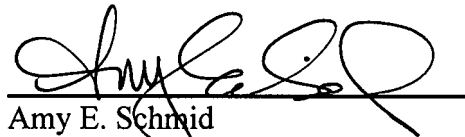
Therefore, in view of the foregoing amendments and remarks, it is submitted that each of the grounds of rejection set forth by the Examiner has been overcome, and that the application is in condition for allowance. Such allowance is solicited.

If, after reviewing this Amendment, the Examiner feels there are any issues remaining which must be resolved before the application can be passed to issue, the Examiner is respectfully requested to contact the undersigned by telephone in order to resolve such issues.

Respectfully submitted,

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